APPENDIX B

SYMBOLS AND SLIDING STABILITY ANALYSIS OF A GENERAL WEDGE SYSTEM

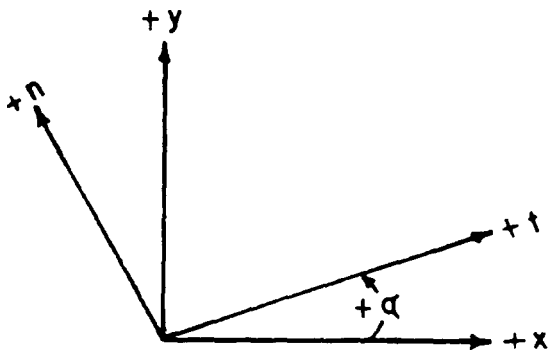
Includes a list of symbols and their definitions as found in drawings showing a derivation of the Governing Wedge Equation for a Typical Wedge. Material in this appendix relates to text in Chapter 4, paragraph 4-9.

LIST OF SYMBOLS

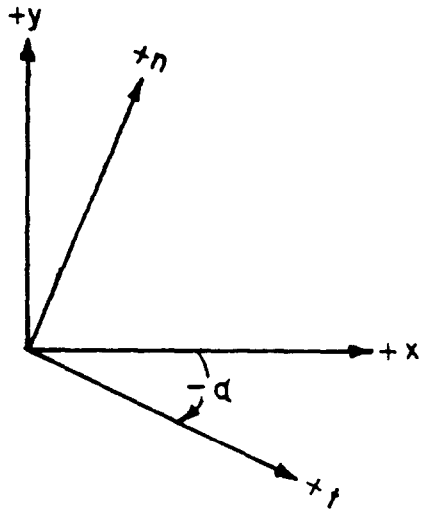
Symbol	Definition
F	Forces.
H	In general, any horizontal force applied above the top or below the bottom of the adjacent wedge.
L	Length of wedge along the failure surface.
N	The resultant normal force along the failure surface.
P	The resultant pressure acting on vertical face of a typical wedge.
FS	The factor of safety.
T	The shearing force acting along the failure surface.
T_F	The maximum resisting shearing force which can act along the failure surface.
U	The uplift force exerted along the failure surface of the wedge.
V	Any vertical force applied above the top of the wedge.
W	The total weight of water, soil, or concrete in the wedge.
C	Cohesion.
α	The angle between the inclined plane of the potential failure surface and the horizontal (positive counterclockwise).
ϕ	The angle of shearing resistance, or internal friction.

NOTE: Subscripts containing i , i-1 , i , i+1 , ... refer to body forces, surface forces, or dimensions associated with the i^{th} wedge.

Subscripts containing Ri or Li refer to the right or left side of the i^{th} wedge.



POSITIVE ROTATION
OF AXES



NEGATIVE ROTATION
OF AXES

The equations for sliding stability analysis of a general wedge system are based on the right hand sign convention which is commonly used in engineering mechanics, The origin of the coordinate system for each wedge is located in the lower left hand corner of the wedge. The x and y axes are horizontal and vertical respectively. Axes which are tangent (t) and normal (n) to the failure plane are oriented at an angle (α) with respect to the +x and +y axes. A positive value of α is a counter-clockwise rotation, a negative value of α is a clockwise rotation,

Figure B-1. Sign convention for geometry

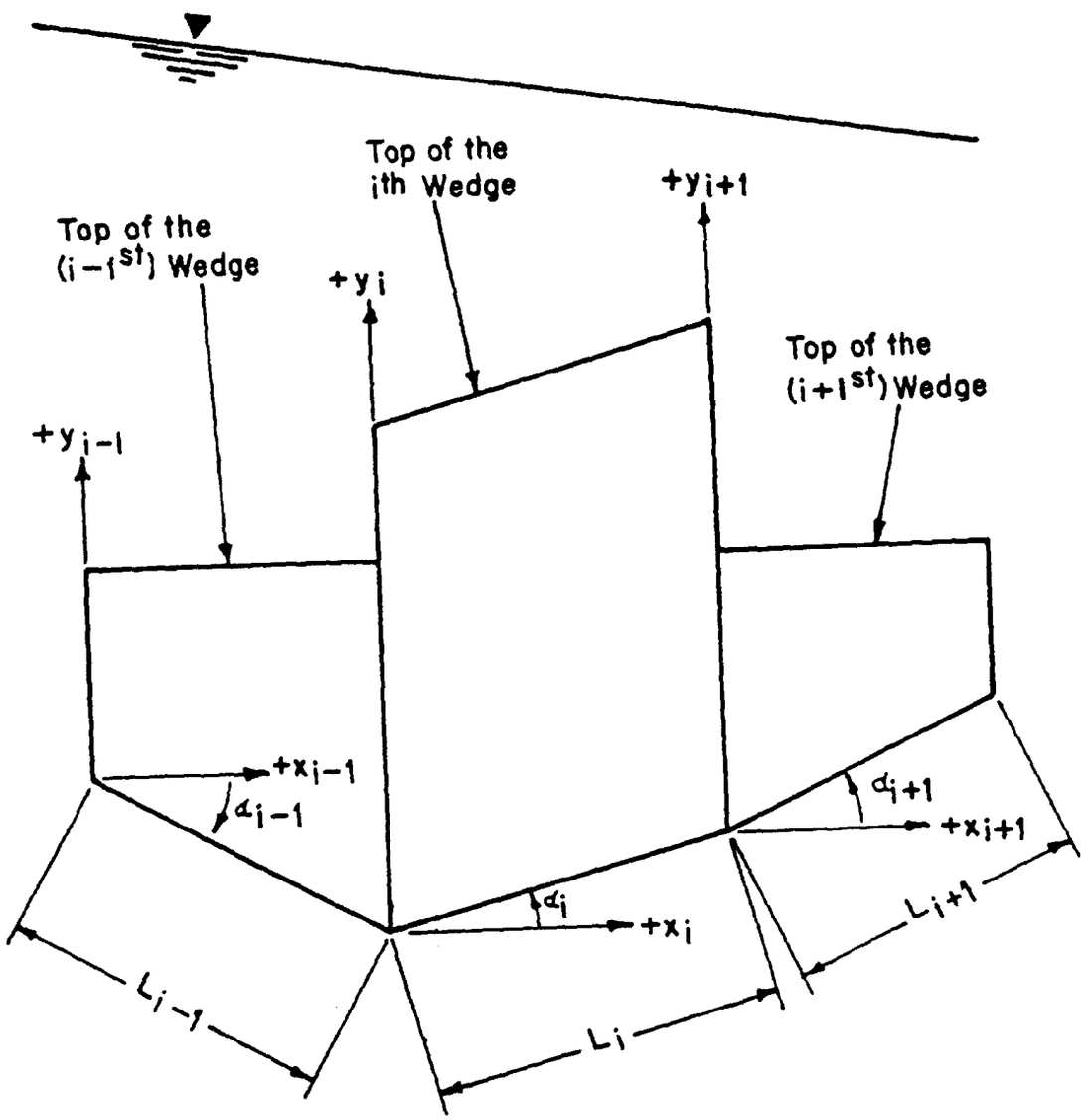


Figure B-2. Geometry of the typical i^{th} wedge and adjacent wedges

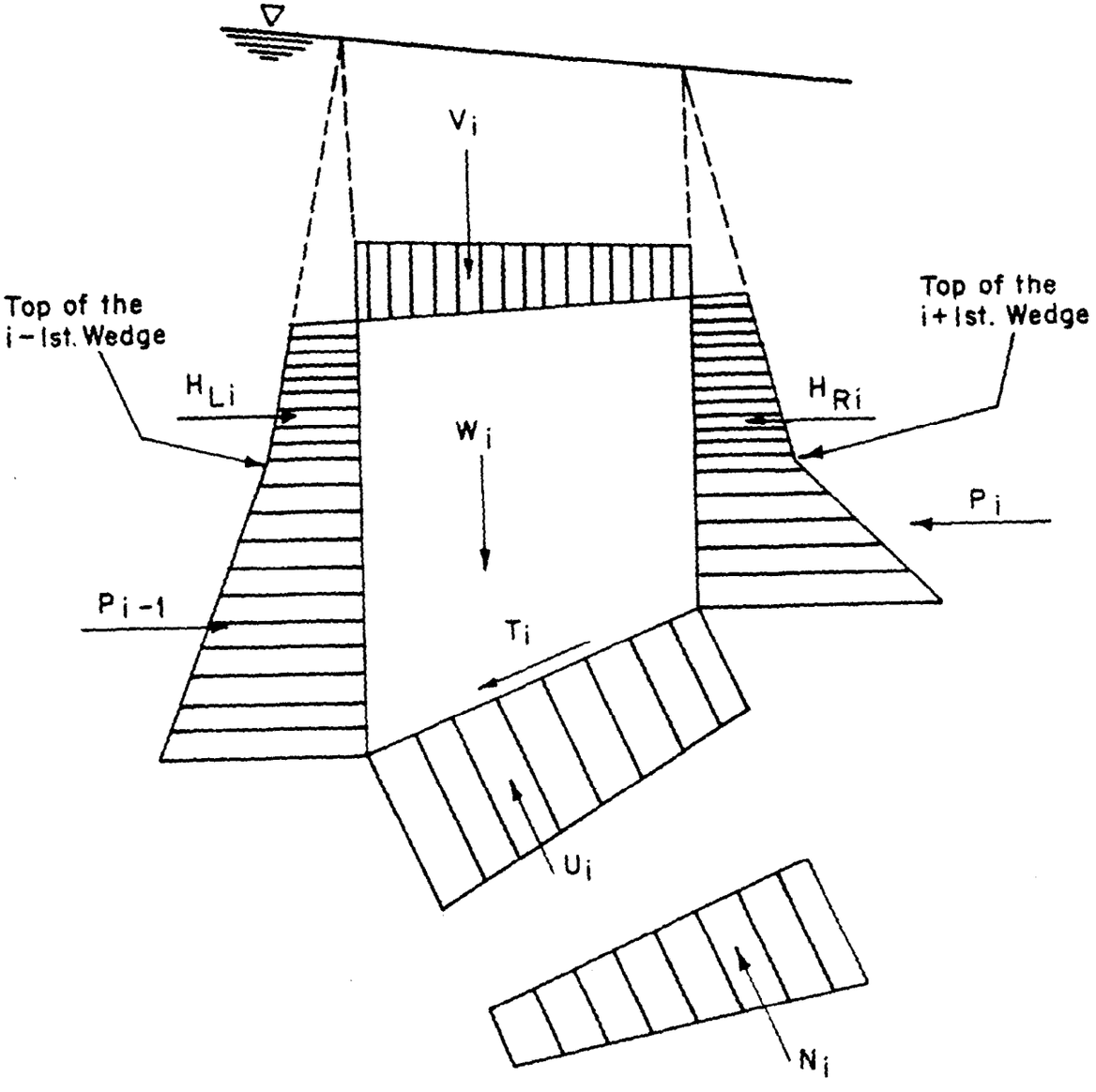


Figure B-3. Distribution of pressures and resultant forces acting on a typical wedge

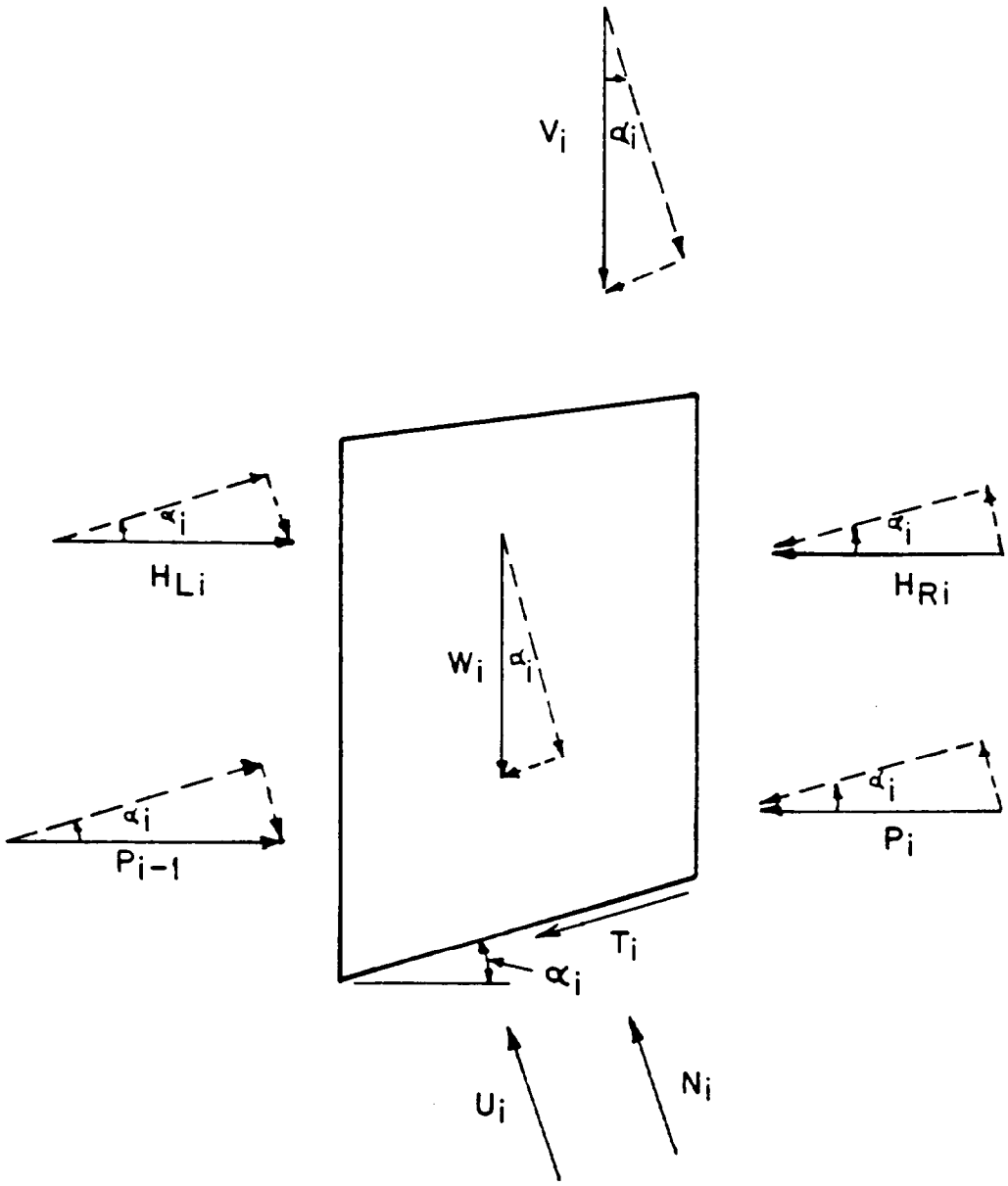
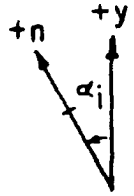


Figure B-4. Free body diagram of the P^h wedge



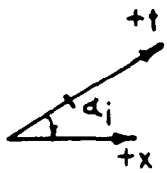
Equilibrium Equations

$$\Sigma F_n = 0$$

$$0 = N_i + U_i - W_i \cos\alpha_i - V_i \cos\alpha_i - H_{Li} \sin\alpha_i + H_{Ri} \sin\alpha_i + \ldots$$

$$\ldots - P_{i-1} \sin\alpha_i + P_i \sin\alpha_i$$

$$N_i = (W_i + V_i)\cos\alpha_i - U_i + (H_{Li} - H_{Ri})\sin\alpha_i + (P_{i-1} - P_i)\sin\alpha_i$$



$$\Sigma F_t = 0$$

$$0 = -T_i - W_i \sin\alpha_i - V_i \sin\alpha_i + H_{Li} \cos\alpha_i - H_{Ri} \cos\alpha_i + \ldots$$

$$\ldots + P_{i-1} \cos\alpha_i - P_i \cos\alpha_i$$

$$T_i = (H_{Li} - H_{Ri})\cos\alpha_i - (W_i + V_i)\sin\alpha_i + (P_{i-1} - P_i)\cos\alpha_i$$

Mohr-Coulomb Failure Criterion

$$T_F = N_i \tan\phi_i + c_i L_i$$

Safety Factor Definition

$$FS = \frac{T_F}{T_i} = \frac{N_i \tan\phi_i + c_i L_i}{T_i}$$

Figure B-5. Derivation of the general equation (Continued)

Governing Wedge Equation

$$FS_i = \frac{\left\{(W_i + V_i)\cos\alpha_i - U_i + [(H_{Li} - H_{Ri}) + (P_{i-1} - P_i)]\sin\alpha_i\right\}\tan\phi_i + c_i L_i}{[(H_{Li} - H_{Ri}) + (P_{i-1} - P_i)]\cos\alpha_i - (W_i + V_i)\sin\alpha_i}$$

$$(P_{i-1} - P_i)\left(\cos\alpha_i - \sin\alpha_i \frac{\tan\phi_i}{FS_i}\right) = \left[(W_i + V_i)\cos\alpha_i - U_i + (H_{Li} - H_{Ri})\sin\alpha_i\right]\frac{\tan\phi_i}{FS_i} + \ldots$$

$$\ldots + \frac{c_i}{FS_i} L_i - (H_{Li} - H_{Ri})\cos\alpha_i + (W_i + V_i)\sin\alpha_i$$

$$(P_{i-1} - P_i) = \frac{\left[(W_i + V_i)\cos\alpha_i - U_i + (H_{Li} - H_{Ri})\sin\alpha_i\right]\frac{\tan\phi_i}{FS_i} - (H_{Li} - H_{Ri})\cos\alpha_i + (W_i + V_i)\sin\alpha_i + \frac{c_i}{FS_i} L_i}{\left(\cos\alpha_i - \sin\alpha_i \frac{\tan\phi_i}{FS_i}\right)}$$

NOTE: A negative value of the difference $(P_{i-1} - P_i)$ indicates that the applied forces acting on the i^{th} wedge exceed the forces resisting sliding along the base of the wedge. A positive value of the difference $(P_{i-1} - P_i)$ indicates that the applied forces acting on the i^{th} wedge are less than the forces resisting sliding along the base of that wedge.

Figure B-5. (Concluded)